Minnesota Ground Water Association
www.mgwa.org

Newsletter

September 2012
Volume 31, Number 3

Featured:

MGWA President Kelton Barr

Inside:

President's Letter

CALLING ALL VOLUNTEERS –

Preparations are well underway for this fall's **57th Midwest Ground Water Conference** that MGWA is hosting. We will have scores of talks in over a dozen technical sessions during the first two days (October 1st and 2nd), a field trip on the third day (October 3rd), a social hour and banquet (and free beer!). It will be a tremendous opportunity to get current on dozens of ground water topics, to hear perspectives, advances, and challenges in ground water from Minnesota and beyond, and to network with your peers throughout the Midwest.

And we need help from you to take care of a plethora of tasks to make this conference a success. We need volunteers to carry out these tasks and to keep the cost of registration as low as possible. Most of these tasks are relatively small and the time required modest. But you will be helping our organization, participating with your friends and peers, and helping to enhance the reputation of Minnesota among the other states. We already have several dozen MGWA members (and others from other states) working on planning, publicity, technical sessions, and sponsorships for the conference. **JOIN IN THE FUN!**—volunteer by contacting MGWA by emailing us at office@mgwa.org.

You can see some results of these efforts on the conference website (www.mwgwc.org), which can also be accessed from the MGWA website (www.mgwa.org). The technical program is posted there, along with other useful information. Take a look and then ***register for the conference!*** It's easy to do electronically.

The Midwest Ground Water Conference will

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Dissipation of Pesticides in Sediment Porewaters of Prairie Potholes

by Teng Zeng and Dr. William A. Arnold, Department of Civil Engineering, University of Minnesota

Introduction

Prairie Pothole Region

Climate, hydrologic forces, geologic modifications, human activities, and many other processes have continuously shaped the Earth's surface and led to the formation of a wide variety of wetlands from mountaintops to seacoasts (Zedler and Kercher, 2005). The Prairie Pothole Region (PPR), which covers approximately 780,000 km^2 of the north-central United States and south-central Canada (Figure 1), contains a significant number of small, shallow, depressional wetlands embedded in a complex landscape of moraines and outwash plains (van der Valk, 2005; Mitsch and Hernandez, 2012). These wetlands, commonly known as prairie pothole lakes (PPLs) or sloughs, were formed upon the retreat of Pleistocene ice sheets (Mitsch and Hernandez, 2012). Most PPLs lack surface inflows or outflows, and their water levels constantly

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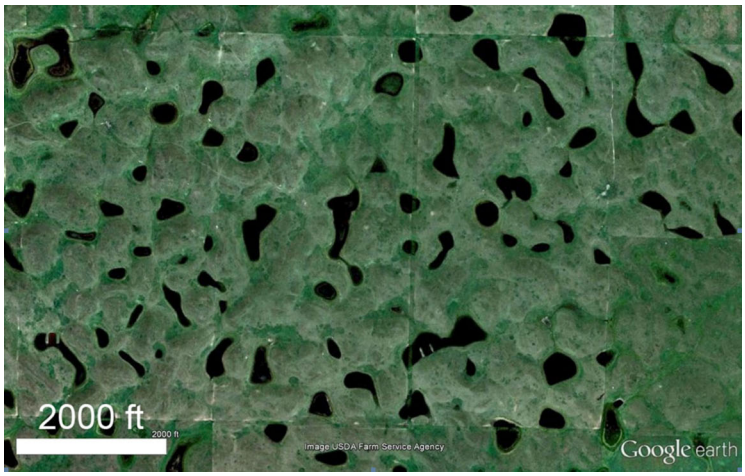

Figure 1. Satellite image showing a high density of prairie pothole lakes in eastern North Dakota. (47°23'33.91"N and 100°37'57.71"W. © 2012 Google and © 2012 USDA Farm Service Agency. [Accessed July 2012]).

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MGWA Web Page
Visit www.mgwa.org for MGWA information between newsletters and to conduct membership and conference transactions.

Newsletter Deadlines

Issue	Due to Editor
December '12	11/02/12
March '13	02/01/13
June '13	05/03/13
September '13	08/02/13

MEMBER NEWS

Tracy Lund is Promoted at MDH

Tracy Lund has accepted a position as an Area Hydrologist in the Drinking Water Protection Section of the Minnesota Department of Health. In her new position, Tracy will be part of the Source Water Protection Unit team of hydrologists and planners. Tracy previously worked as a support hydrologist with MDH.

Mark Umholtz Joins MPCA

Mark Umholtz began working for the MPCA on June 27, 2012, in the Voluntary Investigation and Cleanup Program. Mark will be responsible for providing technical assistance and administrative or legal assurances for property buyers, sellers, developers and other voluntary parties seeking to bring contaminated land back into productive use.

Mark comes to the MPCA with more than 20 years of experience managing and directing air, soil and groundwater contamination investigations and cleanup. Mark has a BS in geology from the University of Wisconsin River Falls.

Greg Small Joins MPCA

Greg Small began working for the MPCA on July 30, 2012, as a Hydrologist/Project Manager in the Superfund Program of the Remediation Division. In this position, he will be responsible for conducting preliminary site assessments as well as managing State and Federal Superfund sites throughout the state of Minnesota. His roles will also include contractor management, project budgeting, technical program development, coordination with USEPA, and public outreach.

Greg's previous work included management of Superfund and Resource Conservation and Recovery Act sites, brownfield redevelopment sites, environmental regulatory compliance, mining environmental issues, and health and safety management for several firms in Colorado, Minnesota, and Wisconsin. He holds an MS in geochemistry from the University of Wisconsin – Milwaukee and a BS in geology from the University of Wisconsin – Eau Claire.

Braun Intertec and Bay West are Ranked Among Top Workplaces

Braun Intertec has been named one of the "Top 100 Workplaces" in Minnesota by the Star Tribune based on an employee-based survey. Braun Intertec ranked number 26 on the list of mid-sized companies. Bay West, St. Paul, appears on a list of 60 additional employers that meet national standards to be designated a Top Workplace. Both companies employ MGWA members.

Star Tribune's Top Workplaces survey recognizes the most progressive Minnesota companies based on employee opinions about company leadership, communication, career opportunities, workplace environment, workplace flexibility, compensation and benefits.

The report can be found on the Star Tribune website: ww2.startribune.com/projects/topworkplaces/TWmasterList2012.html

Two New MGWA Officers Sought for 2013

The MGWA membership needs to fill two officer positions—Treasurer and President-Elect—for the year 2013. The Treasurer oversees MGWA financial matters and assists with meeting planning. The President-Elect takes a leadership role in the planning of one or more of the MGWA meetings while "learning the ropes" of MGWA leadership. Here's a chance for you or someone you nominate to get in on the front end of ground water resource protection in Minnesota.

The Treasurer serves a two-year term, and the President-Elect serves a year before becoming President in 2014, followed by a year as Past-President.

Send nominations by November 1 to MGWA, c/o WRI Association Mgmt Co., 4779 126 th St. North, White Bear Lake, MN 55110, or send an e-mail to office@mgwa.org

AGENCY NEWS

County Well Index to Undergo a Makeover

By Chris Elvrum, MDH

In 2011, the Minnesota State Legislature allocated funds to the MDH to "update" the Minnesota County Well Index (CWI). The funds come from the Clean Water Fund of the Clean Water, Land and Legacy Amendment passed by the Minnesota voters in 2008. In accordance with the amendment, the Clean Water Fund may only be spent to "protect, enhance, and restore water quality in lakes, rivers, and streams and to protect groundwater from degradation. At least five percent of the clean water fund must be spent to protect drinking water sources." www.legacy.leg.mn

The CWI database is the principal source of well construction and subsurface geologic information for state and local agencies as well as the general public. The database contains over 430,000 well records and is jointly managed by the MDH and the MGS. The current CWI evolved from the primordial well record database used in the 1960s by the MGS to manage well information for geologic mapping. In the 1980s, it was used by the MGS to manage the information collected for preparation of County Geological Atlases, hence the 'County' Well Index. There has never been a direct funding source to support CWI though the MDH and the MGS have expanded and made the information available using whatever resources could be scraped together. With the Clean Water Fund appropriation, there is an opportunity to enhance the database to better meet the needs of private and public users.

A process for gathering input on potential enhancements is underway. The MDH has convened a group of stakeholders that includes consultants, well contractors, agencies, counties, the MGS and USGS, and others to provide thoughts for enhancing the database. Some of the ideas generated so far include:

- entering the backlog and historical well records;
- developing tools or processes to improve locational information;
- making scanned images of well records available;
- linking the CWI to databases in other agencies; and
- developing the capability for well contractors to enter well records online.

There were many other useful ideas as well. The MDH is in the process of developing a work plan to implement many of the ideas and would like to give the opportunity for others to submit their own thoughts. There is a link on the MDH website to do so.
www.health.state.mn.us/divs/eh/cwi

Some of the changes to the system will occur in the short term, such as including well sealing records and working on the backlog. Others will take a few years to implement, such as ability to enter well record online. Updates on the progress will be posted on the website listed above.

Hennepin County Environmental Response Fund Will Sunset on January 1, 2013

by Gilbert Gabanski and David Jaeger, Hennepin County Department of Environmental Services, Contaminated Lands Unit

The Hennepin County Environmental Response Fund (ERF) will sunset on January 1, 2013 ending a brownfield cleanup program that was established in 1997. If you are not aware of the program, the ERF provided financial assistance to assess and clean up contaminated properties in Hennepin County, particularly properties that were not eligible for funding from other cleanup programs. During the 2008 legislative session, the original ERF legislation that provided the authority to collect the funds for this program was extended for the last time and set to expire on January 1, 2013. The County's efforts to have the tax sunset date extended further were unsuccessful in both the 2011 and 2012 legislative sessions.

The purpose of the ERF grant program is to fund sites where:

- environmental assessment and cleanup activities have been hampered because there is no other source of funding;
- public non-tax-generating end use is intended (greenfields such as parks);
- moderately-priced market rate and/or affordable housing is being created or preserved; and
- economic development (jobs) will be created.

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The primary objectives of the MGWA are:

- Promote and encourage scientific and public policy aspects of ground water as an information provider.
- Protect public health and safety through continuing education for ground water professionals;
- Establish a common forum for scientists, engineers, planners, educators, attorneys, and other persons concerned with ground water;
- Educate the general public regarding ground water resources; and
- Disseminate information on ground water.

MGWA's Corporate Members for 2012

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Links at www.mgwa.org

Abbreviations and Acronyms

- ASTM – American Society for Testing and Materials
- DNR – Minnesota Department of Natural Resources
- MDA – Minnesota Department of Agriculture
- MDH – Minnesota Department of Health
- MGS – Minnesota Geological Survey
- MPCA – Minnesota Pollution Control Agency
- USEPA or EPA – United States Environmental Protection Agency
- USGS – United States Geological Survey

AGENCY NEWS

Hennepin County ERF, cont.

The ERF program remediates sites, protecting communities and property values, while returning real estate to market-based sales. ERF fills the gap of additional development costs resulting from environmental contamination.

The following is a review of the history, funding, and success of the program.

Background

In 1997, State statute (§383B.80) authorized Hennepin County to collect a mortgage registry and deed tax for deposit into an ERF. ERF funds come from a 0.01% (1/100th of one percent) mortgage registry and from a 0.01% deed tax in Hennepin County, equivalent to $30 on a $150,000 property sale.

In broad terms, the ERF was to be used for the clean up of contaminated sites within Hennepin County. According to the statute the first priority for the ERF was the NL Industries/ Tara Corporation/Golden Auto site in St. Louis Park ($4.95 million). After the money required for the NL Industries/Tara Corporation/Golden Auto site was allocated, the remainder of the ERF was available for other sites within Hennepin County. The authority to collect the tax originally expired on January 1, 2003. Hennepin County's taxing authority was extended to January 1, 2013 by 2002 and 2008 amendments to State Statute §383B.80.

Since then the statutory priority site in St. Louis Park has been cleaned up and redeveloped, and the grant program has completed 22 semi-annual funding rounds, extending a total of $41,210,528 via 288 individual grants, including 15 emergency grants. In Hennepin County alone, the ERF typically provides approximately $4 million each year for environmental assessment and cleanup related costs.

Program Success

Since 2001, ERF-funded projects have:

- created or retained 10,000 jobs;
- increased property values by more than $433 million when comparing pre- and post-cleanup values;
- created or renovated approximately 3,500 affordable and 6,500 market-rate housing units;
- generated $13 million more in property taxes in 2011 from completed ERF-aided projects than was generated by these same properties prior to ERF involvement;
- from 2003 to 2011, generated $48 million more in property taxes than was generated by these same properties prior to ERF involvement;
- leveraged $1.7 billion in privately funded development costs; and
- leveraged $53 million in public investments from the MN Department of Employment and Economic Development, Met Council's Tax Base Revitalization Account, and federally funded cleanup grant programs.

The ERF has restored properties to standards required for redevelopment resulting in returning vacant, blighted properties to market value sales and protecting surrounding property values. The program has transformed sites from safety nuisances into community assets thereby reducing crime.

The program is one of the only financial sources for abatement of asbestos and lead-based paint for residential properties; and over $5 million has been granted to non-profits for performing these types of cleanups. Financial institutions will not support asbestos and lead-based paint abatement.

Future of the Program

There is a great need for the assistance provided by the ERF. Although we plan to have a fall 2012 grant round, the future beyond then is uncertain. We plan to approach the legislature in the spring 2013 and attempt to reinstate the program; but that too is uncertain.

As a side note, Ramsey County's ERF program was also not extended, and it too will sunset on January 1, 2013.

MDH Develops Health-based Guidance for Manganese

Reprinted with permission from the Minnesota Department of Health Newsletter, The Waterline; Fall 2012

The Minnesota Department of Health has developed health-based guidance for manganese, a naturally occurring contaminant that has been associated with aesthetic problems in water. Many utilities treat their water to reduce manganese levels to eliminate discolored water.

The U. S. Environmental Protection Agency secondary maximum contaminant level of 50 micrograms per liter (ug/L) is based on aesthetics, but levels around the state are often higher. Two levels of guidance, 100 and 300 ug/L, have historically been in use in Minnesota. MDH's new guidance is to use the 100 ug/L level to protect infants (under one year of age who are formula-fed or given plain tap water) and 300 ug/L to protect children one year of age and older and all adults.

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Bemidji Research Site - A Student's Experience

by Ryan Streitz, University of St. Thomas

My first professional opportunity as a researcher presented itself this summer and turned out to be quite the adventure! As part of an undergraduate research project funded by a grant from the University of St. Thomas*, I ventured to the National Crude Oil Spill Fate and Natural Attenuation Research Site in Bemidji, Minnesota with fellow undergraduate students Ben Ruhme and Brady Ziegler. My work focused on studying the biodegradation of ethanol and BTEX (benzene, toluene, ethylbenzene, and xylene) from petroleum hydrocarbon spill plumes in wetland environments. To test this, experiments were designed to monitor the rate of bacterial attenuation (consumption) of the organic hydrocarbons from the crude oil. My interest in this project was sparked upon learning of the recent formulation of ethanol and BTEX into E85 that is stored and used for fuel.This project will ultimately modify the framework that has been built on understanding how these oil spills will behave. This has led to a variety of hypotheses by many scientists on the attenuation rate of ethanol blends in soils. Some suggest ethanol will inhibit the rate of biodegradation of BTEX, while some suggest it will enhance the rate of biodegradation of BTEX. The intention for this experiment is to serve as a contributing study to better understand how natural attenuation of crude oil is affected when it is mixed with ethanol. I am currently generating data from the field samples and hope to have a paper ready by fall of 2012.

The research team. Upper left to right: Ryan Streitz, Isabelle Cozzarelli, and Ben Ruhme. Lower left to right: Nicole Fahrenfeld and Brady Ziegler. Not shown: Jennifer McGuire, Jeanne Jaeschke, and Erik Smith.

The Bemidji Site's field crew was garrisoned with the support of the USGS over a short two-week window in the middle of June. Also accompanying us were Ph.D. students from around the country, independently funded researchers, and some undergraduate students from the University of Minnesota. We arrived at the field site on a pleasant June afternoon with a 12-passenger van loaded to the brim with instruments and equipment. From there, we set up a base camp and began building a temporary laboratory. Once all research teams had unloaded and began research the field became a metropolis of vehicles buzzing around the site, drill rigs pounding out core, and teams of researchers intermingling in tight quarters.

We survived field days by eating ham sandwiches topped with salsa and mustard (possibly the greatest discovery made on the trip), drinking thermoses of watery hotel "coffee," and listening to Bemidji's pop radio stations – which played a variety of 1980's best musical offerings. Field dress became a fashion statement only boasted while at the site. To ward off ticks and bugs, I dressed in large rubber boots, tube socks tucked forcibly into my jeans, a loosely tucked in shirt, and a bandana. The only thing that could get me now was the blistering heat. Luckily, the perks of working in tandem with the federally funded USGS meant all-access to an air-conditioned RV and ice-cold water.

Ryan Streitz extracting water samples from a wetland well in Bemidji.

With the help of my faculty advisor Jennifer McGuire, I also got the opportunity to work with the USGS to collect data on wells, help with core extraction, and take multiprobe "YSI" or "lake flow-cell surveys" for water chemistry readings of water columns. Perhaps the most exciting moment of the trip came when we hit oil (from the 1979 Bemidji oil spill) while monitoring a previously clean well. Not only did this suggest that the plume was moving, but it also gave us a first hand look at the mess an oil spill causes. It's some nasty stuff! One damaged pump and three buckets of oil later, we were left wondering if we just made a huge discovery or a huge mistake. Turns out there were no hard feelings, but some funny oil jokes to be made at our expense.

The two-week stay quickly came to an end, turning the once bustling camp into a complete ghost town. The field mentality of the trip was simple: work hard, efficiently, and safely. Even minor setbacks could be the difference between obtaining a complete dataset or nothing at all. Mission accomplished.

** Research was made possible in part by a collaborative venture of the USGS, the MPCA, Beltrami County, and Enbridge Energy.*

Pesticide Dissipation in Prairie Pothole Sediments, cont.

fluctuate in response to seasonal and interannual changes in groundwater, precipitation, runoff, as well as evapotranspiration (van der Valk, 2005). Collectively, PPLs and associated watersheds constitute one of the largest inland wetland systems, (van der Valk, 2005) and are of unparalleled importance to a diverse community of waterfowl, invertebrates, and plants (Kantrud *et al*., 1989). In particular, prairie wetlands serve as critical breeding habitats and migration corridors for about 20 million ducks of 12 species and produces from 50% to 75% of the continent's duck population (van der Valk, 2005; Mitsch and Hernandez, 2012). Meanwhile, prairie wetlands are known to provide other essential ecological functions such as groundwater recharge, floodwater storage, sediment reduction and carbon sequestration (Gleason *et al*., 2008).

Agricultural Impacts

Over the past 150 years, agricultural drainage has resulted in a 70% loss of native prairie wetlands, making the PPR among most extensively altered ecosystems on Earth. A significant portions of the PPR in Iowa, western Minnesota, and eastern North and South Dakota have experienced comprehensive drainage through drainage tile and ditch networks (Anteau, 2012). The loss of Minnesota prairie wetlands reached over 85% by the 1980s (Johnson *et al.*, 2008). From 1980 to 2007, 4.3% of the wetlands have been drained with losses varying from 0 to 15% among ecological subsections (Oslund *et al.*, 2010). The large-scale drainage of PPLs and concomitant removal of vegetation have exerted a profound and negative impact on prairie wildlife, thereby compromising the overall biodiversity and productivity of the PPR. For instance, a five-county area in central western Minnesota that once supported about 300,000 breeding duck pairs merely supports less than 60,000 breeding pairs today (Johnson *et al.*, 2008). In concert with a growing awareness of the ecological importance of these ecosystems, major efforts (e.g., the Conservation Reserve Program and Wetland Reserve Program) have been undertaken over the past two decades to ameliorate the loss of PPLs (Dahl, 2006; Watmough and Schmoll, 2007). In recent years, however, there seem to be renewed incentives to expand agriculture in the PPR for production of organic crops and corn-based biofuels (Johnson *et al*., 2008).

Pesticide Fate

PPLs are at a high risk of trapping nonpoint source pollutants, such as pesticides and nitrogen and phosphorus fertilizers, because many of them are located on or closely surrounded by farmland and directly or indirectly impacted by adjacent agricultural land uses and management practices (Goldsborough and Crumpton, 1998). Pesticides may enter PPLs via several routes, including application drift, deposition of wind-eroded soil, surface runoff, and wet and dry atmospheric deposition (Degenhardt *et al*., 2011). A number of pesticides, such as 2,4-D, atrazine, bentazon, bromoxynil, and metolachlor, have been frequently detected in prairie aquatic systems (Donald *et al*., 2007; Johnson and Gray, 2011). Pesticides released into prairie wetlands may threaten the population sizes of aquatic invertebrates as well as the reproductive success and survival rates of waterfowl (Donald *et al*., 1999). Thus, concerns have been raised about the disruptive effects of these chemicals on the ecological integrity of the region (Donald *et al*., 1999). Previous studies have considered sorption to suspended particles and eventual deposition to sediments as a major pathway for the dissipation of pesticides from the water column of PPLs (Huckins *et al*., 1986; Degenhardt *et al.*, 2011; Degenhardt *et al.*, 2012). Pesticides sorbed on redox-sensitive surfaces of sediment particles, however, can potentially solubilize under anoxic conditions and leach into groundwater if the PPL serves as a groundwater recharge site (Olness *et al*., 1996). Knowledge about the fate and persistence of pesticides in the PPL sedimentary environment, therefore, is crucial for assessing likely consequences of such process.

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President's Letter, cont.

be comparable but better than last fall's GSA National Meeting in Minneapolis--*comparable* in having dozens of talks on current topics taking place over several days, *better* in that it's all about ground water. The talks are germane to Minnesota professionals, and the cost is lower (not to mention there's free parking and free beer).

So please VOLUNTEER to help, REGISTER to attend, and we will see you at the Midwest Ground Water Conference!

Manganese Guidance, cont.

Manganese is an essential element in people and is needed in small amounts to maintain health. Most people get sufficient amounts from food, and infants younger than one year of age get adequate amounts from breast milk, food, or formula. Too much manganese, however, is a concern for infants, whose brains are still developing and who could consume more manganese-contaminated water based on body weight than older children or adults. Recent research shows that too much manganese from drinking water could affect learning and behavior in infants and young children.

Breast milk, which contains healthy amounts of manganese, is best for infants. Formula-fed babies may get too much manganese in their bodies if the formula they drink is mixed with water that contains high levels of manganese.

Customers who receive water from a public water system should check with their utility to learn whether the utility has tested for manganese and, if so, what the levels are in the treated water. People with private wells, especially with young infants, should test their water and use a proper filter to remove manganese from tap water given to infants if the levels exceed 100 ug/L. Tap water consumed by all people should be filtered if manganese is found at levels above 300 ug/L.

www.health.state.mn.us/divs/eh/risk/guidance/gw/manganese.html

Photos from the Archives

The Newsletter team is pleased to announce a new feature devoted to the sharing of photos that capture the interesting work performed by our members. Our first photo demonstrates an almost-forgotten method of taking water levels and reminds us of how commonplace smoking was in the late 1970s. This photo was taken at the site of the 1979 Bemidji oil spill, during the burn off of the surface oil. (For more about some recent activities a this site, please see the article by Ryan Streitz on page 5 of this issue.)

Do you recognize the man in this picture? If so, please let us know at editor@mgwa.org. Finally, please send us photos, copies or scans that you believe may be of interest to the readers of the Newsletter.

Pesticide Dissipation in Prairie Pothole Sediments, cont.

Research Motivation

One unique aspect of PPLs is that most of them have evolved high sulfate levels in the surface water (SO_4^{2-}; typically on the order of 10-100 mM (LaBaugh, 1989)), which arises from recharge by sulfate-saturated groundwater and high evapotranspiration relative to precipitation (Winter and Rosenberry, 1998; Goldhaber *et al*., 2011). Thus, the microbially-driven sulfate reduction is perceived as a predominant process in anoxic PPL sediments, and reduced sulfur species formed upon sulfate reduction, such as bisulfide (HS^-; see Equation 1) and polysulfides (S_n^{2-}; see Equation 2, n represents sulfur chain length and typically ranges from 2 to 5), are likely to exist in appreciable amounts in sediment porewaters.

$$(1)\ SO_4^{2-} + 8e^- + 9H^+ \rightarrow HS^- + 4H_2O$$

$$(2)\ HS^- + (n-1)/8\ S8(s) \rightleftharpoons S_n^{2-} + H^+$$

Previous studies have shown that both HS^- and S_n^{2-} can act as nucleophiles and/or reductants to rapidly degrade a wide array of pesticides in well-defined aqueous solutions (Loch *et al*., 2002; Wang and Arnold, 2003). We therefore hypothesized that these sulfur species could act as environmental reagents to promote the removal of pesticides entering PPLs. The main objective of this work was to quantify the role of reduced sulfur species in the abiotic transformation of chloroacetanilide (e.g., acetochlor) and dinitroaniline (e.g., ethalfluralin) pesticides in PPL sediment porewaters. These two classes of pesticides were investigated owing to their extensive use in the PPR. To this end, a series of laboratory batch experiments were performed using PPL sediment porewaters to investigate pesticide reaction kinetics and products.

Methods

Sediment Sampling and Porewater Collection

Our sampling sites are located within the USGS Cottonwood Lake study area, Stutsman County, North Dakota (Figure 2). Long-term biological, chemical, and hydrological conditions of wetlands in this area have been monitored since 1966 (Mushet and Euliss, 2012). Several batches of sediment cores were collected in 2010 from two semipermanent PPLs (i.e., P1 and P8) using a punch-core technique and transported to the University of Minnesota within 24 hours. Bulk sediment porewaters were extracted by centrifugation and promptly transferred into an anaerobic glove box (95% N_2/5% H_2). Further manipulations of these porewaters were performed in the glove box to prevent the loss of reduced sulfur species from oxidation. Prior to pesticide transformation experiments, sub-samples of porewaters were analyzed for the concentrations of HS^- and S_n^{2-} using established derivatization methods (Zeng *et al*., 2011).

Pesticide Transformation Studies

Batch pesticide transformation experiments were conducted in 10 mL foil-wrapped, zero-headspace glass syringes. Reactions were initiated by spiking an aliquot of pesticide methanolic stock solution into sediment porewaters. A 0.5-mL aliquot of aqueous sample was withdrawn from syringes at specific time intervals and extracted with hexane or ethyl acetate (extraction efficiencies for pesticides were determined to be >90%). (Zeng *et al*., 2011; Zeng *et al*., 2012) Control syringes containing buffer solutions were prepared, sampled, and analyzed in the same way to account for the loss of pesticides via other pathways (e.g., sorption and hydrolysis). All solvent extracts were analyzed by gas

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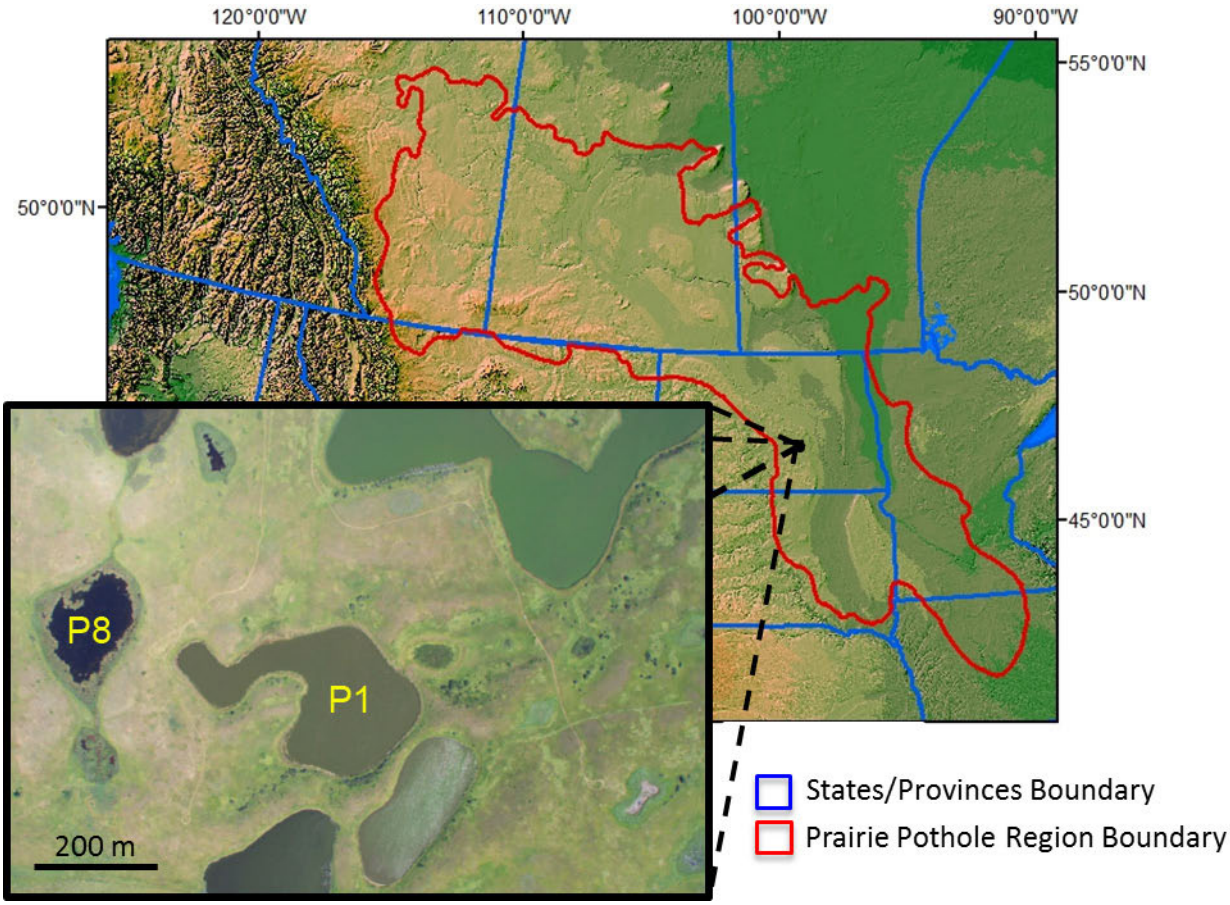

Figure 2. Location and photograph of P1 and P8 within the Cottonwood Lake study area (CLSA), North Dakota. PPR and CLSA images courtesy of Dr. David N. Mushet, USGS Northern Prairie Wildlife Research Center.

chromatography for the quantification of target pesticides and the identification of reaction products. Pesticide reactions were modeled assuming the pseudo-first-order kinetics.

Results and Discussion

PPL Porewater Chemistry

The chemistry of bulk porewaters extracted from P1 and P8 sediment samples are summarized in Table 1. The average concentrations of HS^- and S_n^{2-} in two PPL porewater samples reached ~2100 µM and ~60 µM, which are as high as the levels typically found in marine sediment porewaters and sulfidic lake waters. Furthermore, the levels of dissolved organic matter (DOM) in these PPL porewaters ranged from 70 to 110 mg C/L, which are among the highest ever reported for wetlands and lakes.

Pesticide Reaction Kinetics

As shown by Figure 3, both acetochlor and ethalfluralin underwent rapid dissipation in PPL sediment porewaters without any lag phase. In contrast, no apparent reactivity of pesticides was observed in the control buffer solutions. Semilogarithmic plots for the reaction time courses also indicated that the transformation of pesticides indeed obeyed pseudo-first-order kinetics (data not shown). For comparison purposes, Table 2 presents estimated half-lives of acetochlor and ethalfluralin in different environmental media. Notably, the half-lives of these two pesticides in PPL sediment porewaters were two orders of magnitude shorter than those predicted in aquatic sediments, suggesting that the presence of HS^- and S_n^{2-} might play a vital role.

Role of Bisulfide and Polysulfides

An analysis of reaction kinetics data has allowed us to assess the relative importance of HS^- and S_n^{2-} in the overall pesticide transformation. Assuming pseudo-first-order kinetics, the observed pesticide reaction rates (*kobs*) can be approximated by summing rates of all concurrent reaction pathways (Equation 3):

$$(3)\quad kobs = kHS^- \cdot [HS^-] + kS_n^{2-} \cdot \Sigma[S_n^{2-}] + kother$$

where kHS^- and kS_n^{2-} are the second-order rate constants for reactions of pesticides with HS^- and S_n^{2-}, and *kother* is the rate constant for other processes. The contributions of HS^- and S_n^{2-} to *kobs* were estimated by multiplying their concentrations (i.e., $[HS^-]$ and $\Sigma[S_n^{2-}]$; see Table 1) in the porewaters and the second-order rate constants available from literature. With this approximation, the percent contributions of HS^- and S_n^{2-} to the overall reactivity of acetochlor and ethalfluralin in sediment porewaters are illustrated in Figure 4.

For acetochlor, the contribution from HS^- accounts for the majority of *kobs* (~65%), while another main fraction of *kobs* (~30%) can be attributed to S_n^{2-}. For ethalfluralin, the reaction with HS^- explains a large portion of *kobs* (~33%), with a smaller fraction of *kobs* (~15%) arising from S_n^{2-}. Although the observed concentrations of S_n^{2-} were two orders of magnitude lower than that of HS^- (see Table 1), the role of S_n^{2-} in pesticide reactions remained significant owing to its inherently higher reactivity than HS^-.

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Pesticide Dissipation in Prairie Pothole Sediments, cont.

Table 1. Chemistry of PPL sediment porewaters

Sample	Sampling Date	pH	$[HS^-]$ (μM)	$\Sigma[S_n^{2-}]$ (μM)	DOM (mg C/L)
P1[a]	Apr 2010	8.62	2347 (±64)	74.4 (±3.8)	72.1 (±0.4)
P8[b]	Apr 2010	8.78	1984 (±21)	43.4 (±2.1)	114.0 (±0.1)

[a] Adapted with permission from (Zeng, T.; Ziegelgruber, K. L.; Chin, Y.-P.; Arnold, W. A., Pesticide processing potential in prairie pothole porewaters. *Environ. Sci. Technol.* 2011, *45*, 6814-6822.). Copyright (2011) American Chemical Society. [b] Adapted with permission from (Zeng, T.; Chin, Y.-P.; Arnold, W. A., Potential for abiotic reduction of pesticides in prairie pothole porewaters. *Environ. Sci. Technol.* 2012, *46*, 3177-3187.). Copyright (2012) American Chemical Society.

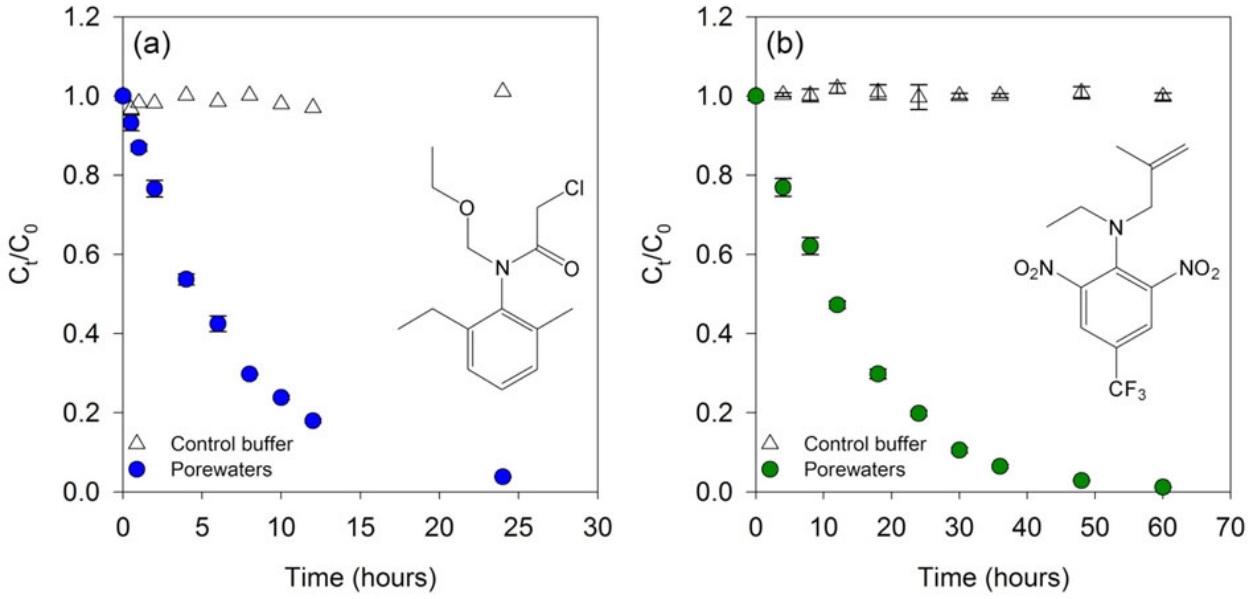

Figure 3. Transformations of pesticide in PPL sediment porewaters: (a) acetochlor; (b) ethalfluralin. Error bars represent one standard deviation of duplicate samples. Note differences in time scales. Data for acetochlor adapted with permission from (Zeng, T.; Ziegelgruber, K. L.; Chin, Y.-P.; Arnold, W. A., Pesticide processing potential in prairie pothole porewaters. Environ. Sci. Technol. 2011, 45, 6814-6822.). Copyright (2011) American Chemical Society. Data for ethalfluralin adapted with permission from (Zeng, T.; Chin, Y.-P.; Arnold, W. A., Potential for abiotic reduction of pesticides in prairie pothole porewaters. Environ. Sci. Technol. 2012, 46, 3177-3187.). Copyright (2012) American Chemical Society.

It should also be noted that direct reactions of pesticides with reduced sulfur species alone could not fully explain the observed kobs (i.e., kother = 5-50%), suggesting that other porewater constituents might also contribute to the transformation of pesticides. For instance, DOM in porewaters might act as an effective electron transfer mediator to accelerate the reductive transformation of ethalfluralin.

To verify the importance of reduced sulfur species with respect to pesticide reactions, further attempts were made to characterize the reaction products. The identification of pesticide reaction products revealed that reduced sulfur species indeed played a dual role as nucleophiles and reductants. Specifically, acetochlor appeared to react with reduced sulfur species via nucleophilic substitution pathways (i.e., displacement of chlorine atom by HS^- and S_n^{2-}; see Figure 5a), while ethalfluralin reacted via reduction pathways (i.e., sequential reduction of both nitro groups to amine by HS^- and S_n^{2-}; see Figure 5b).

Summary

Our study showed that reduced sulfur species, such as bisulfide (HS^-) and polysulfides (S_n^{2-}), existed in great abundance in PPL sediment porewaters. Two target pesticides (i.e., acetochlor and ethalfluralin) readily underwent degradation in PPL porewaters with half-lives on the order of hours. The analysis of reaction products provided compelling evidence that naturally occurring reduced sulfur species served as both nucleophiles and reductants to effectively promote the transformation of these two classes of pesticides. Overall, results from this study demonstrate that PPLs are critical landscape elements for the natural attenuation of pesticides, which provides an additional justification for the continued protection and restoration of prairie wetlands.

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Table 2. Persistence of target pesticides in the environment

Pesticide	Class	Estimated mean half-life (hours) in[a]				
		Atmosphere	Soil	Surface water	Aquatic sediment	PPL porewaters[b]
Acetochlor	Chloroacetanilide	100-300	1000-3000	1000-3000	3000-10000	12
Ethalfluralin	Dinitroaniline	100-300	1000-3000	1000-3000	3000-10000	10

[a] Values taken from (Barbash, 2007) for comparison purpose.

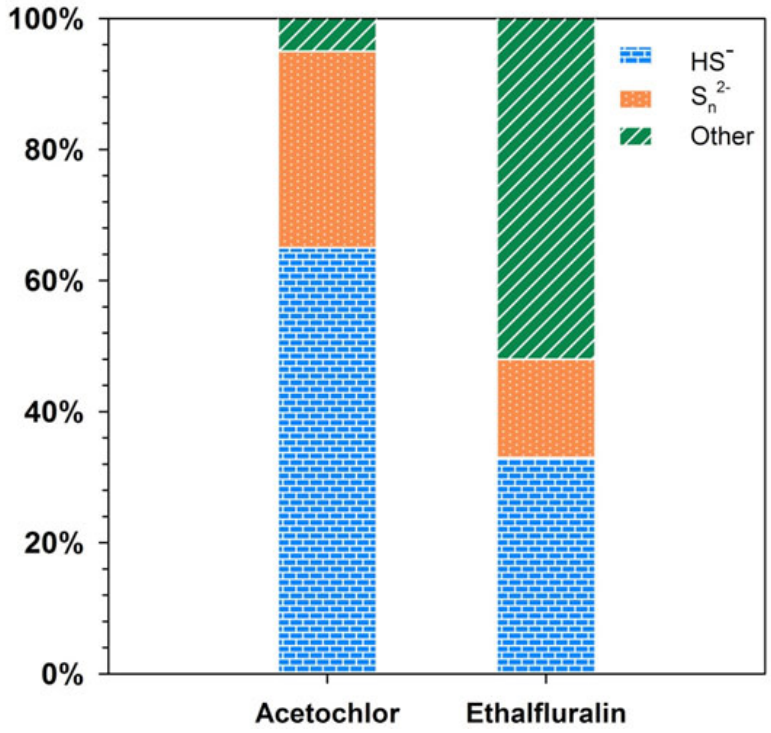

Figure 4. Percent contributions of HS^-, S_n^{2-}, and other processes to pesticide transformations in PPL sediment porewaters. Data for acetochlor adapted with permission from (Zeng, T.; Ziegelgruber, K. L.; Chin, Y.-P.; Arnold, W. A., Pesticide processing potential in prairie pothole porewaters. Environ. Sci. Technol. 2011, 45, 6814-6822.). Copyright (2011) American Chemical Society. Data for ethalfluralin adapted with permission from (Zeng, T.; Chin, Y.-P.; Arnold, W. A., Potential for abiotic reduction of pesticides in prairie pothole porewaters. Environ. Sci. Technol. 2012, 46, 3177-3187.). Copyright (2012) American Chemical Society.

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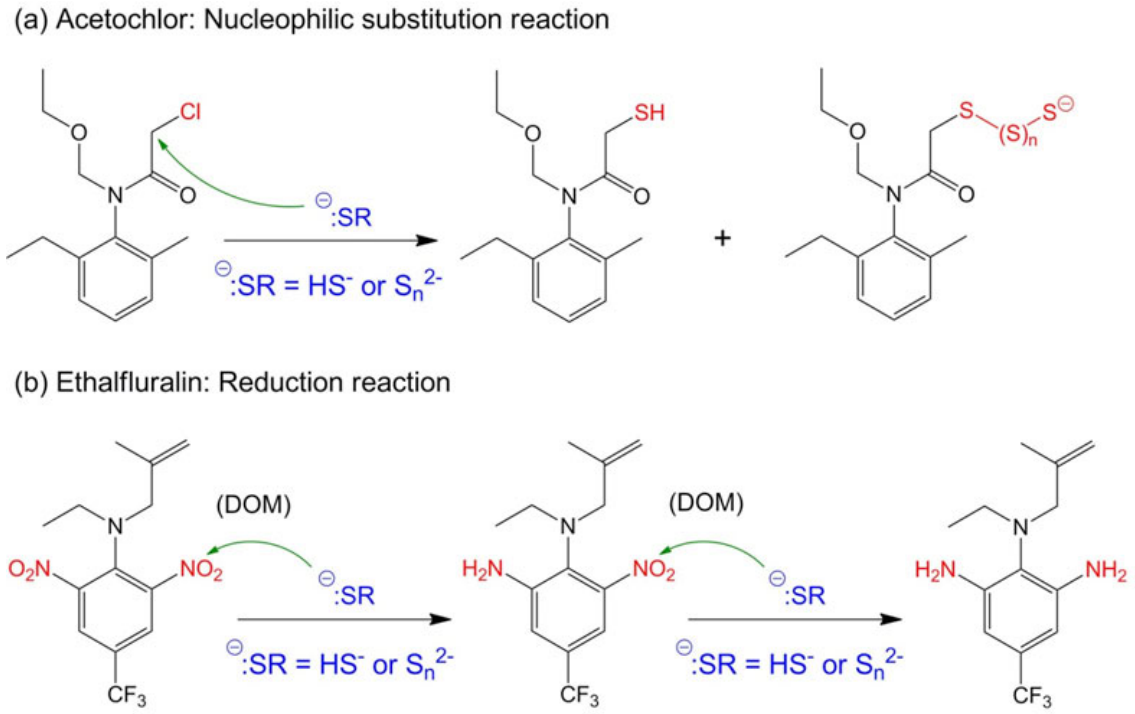

Figure 5. Reaction schemes of pesticides with reduced sulfur species: (a) Nucleophilic substitution of acetochlor with HS^- and S_n^{2-}. The chlorine atom is displaced by HS^- or S_n^{2-}. (b) Sequential reduction of ethalfluralin by HS^- and S_n^{2-}. The two nitro groups are reduced to amine groups. "DOM" denotes dissolved organic matter that might act as an electron transfer mediator to facilitate the reduction.

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Stormwater Runoff to Baseflow? Understanding Surface-Groundwater Interactions in Minnehaha Creek

by Trisha Moore and Dr. John Gulliver, St. Anthony Falls Laboratory, University of Minnesota; Dr. John Nieber and Dr. Joe Magner, Department of Bioproducts and Biosystems Engineering, University of Minnesota

Famous for its 53-ft falls, Minnehaha Creek ranks among the Twin Cities' most popular natural features and attracts over half a million visitors annually. The creek, which flows 22 miles from its origin at Lake Minnetonka to its confluence with the Mississippi River in south Minneapolis (Figure 1), is also popular among canoeists and kayakers. Despite supporting several flour mills during the mid-19th century, flow in Minnehaha Creek today is often reduced to a trickle and has experienced zero-flow conditions in eight of the last 12 years. The frequency of low flow conditions in the creek diminish the recreational and aesthetic opportunities enjoyed by locals and visitors alike and contribute to the creek's impaired status for biological integrity.

Local interest in enhancing Minnehaha Creek's ecosystem has spurred investigations of flow conditions in the creek. Improved stormwater management may provide one means of improving the creek's flow. Currently, the majority of stormwater runoff in the watershed is conveyed to the creek via storm sewer networks, resulting in a rapid rise and fall in streamflow. We hypothesize that strategically infiltrated stormwater runoff could be stored in the surficial aquifer system and slowly released to augment existing baseflow sources and improve drought flow conditions in the creek. Evaluating the potential for stormwater infiltration to supplement baseflow in Minnehaha Creek first requires an understanding of current interactions between the creek and its shallow aquifer system. We are developing this understanding through a variety of approaches, including analyses of historical streamflow records and field measurements. Each of these methods, and the insights gained thus far, is summarized in the following sections.

Study area hydrology and geology: an overview

The Minnehaha Creek watershed encompasses a total of 170 square miles (mi^2), 47 mi^2 of which lie below Lake Minnetonka's outlet at Grays Bay. Flow in Minnehaha Creek is heavily dependent on discharge from Lake Minnetonka, the outlet of which is controlled to manage water elevations in the lake. When precipitation is sufficient to maintain adequate levels in the lake, the outlet remains open and flow in the creek is sustained. However, when the lake level drops below a prescribed elevation, the outlet is closed and baseflow in the creek is reliant upon other sources, including storage released from riparian wetlands, discharge from Lake Harriet – the lowermost lake of the "Chain of Lakes" in

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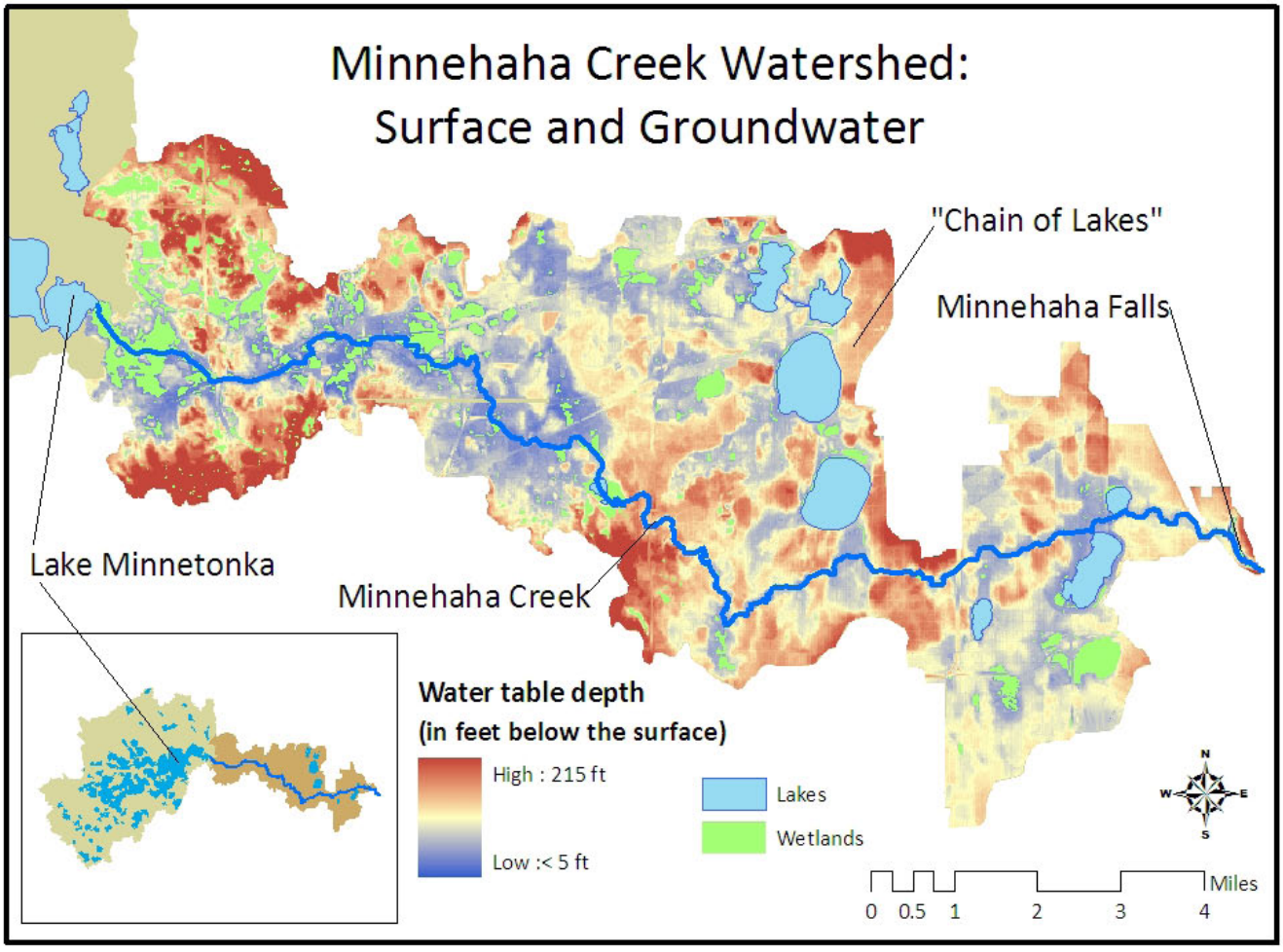

Figure 1. In addition to controlled discharge from its origin at Lake Minnetonka, other sources of surface water to Minnehaha Creek include storage in riparian wetlands (green shading) and discharge from the Minneapolis "Chain of Lakes." Regional mapping of the Quaternary aquifer indicates near-surface groundwater along the upper one-third of the creek (Metropolitan Council, 2009).

south Minneapolis – and the surficial aquifer system (Figure 1). The lower watershed is underlain by a relatively thick (average 80 ft) layer of Quaternary-age sediments, the predominant textures of which are sand and gravel (Meyer, 2007). Below this lie a series of bedrock aquifers, the uppermost of which is the Platteville Limestone. The vertical travel time of water through the Quaternary layer has been calculated by Tipping (2011) for the Twin Cities Metro Area. In accordance with the coarse textured sediments found in the area, vertical transit in the lower Minnehaha Creek watershed was rapid, with a median value of 0.5 years to travel from the land surface to the uppermost bedrock unit (Figure 2).

Streamflow-based estimates of groundwater contributions

As a preliminary estimate of existing groundwater contributions to the creek, we utilized historical discharge data as input to streamflow-based models of groundwater recharge and discharge. Six years (2006-2011) of daily discharge measurements from a USGS gauge located about one mile upstream of the creek's confluence with the Mississippi River were used as inputs. Groundwater recharge was estimated using RORA, a program developed by the USGS to produce estimates of groundwater recharge based on the recession curve displacement technique outlined by Rorabaugh (1964). Groundwater discharge was then estimated from the streamflow record using both the program PART and a baseflow separation algorithm. PART is a streamflow partitioning method in which streamflow is assumed equal to groundwater discharge during periods of hydrograph recession that meet specified requirements for the duration of antecedent recession. Linear interpolation is used to obtain values of groundwater discharge during surface runoff events occurring between recession periods. As another method of discharge estimation, the digital filter adopted by Nathan and McMahon (1990) to separate streamflow into its surface flow and baseflow components was also applied to the flow record. One of the underlying assumptions of these methods is that streamflow is not regulated; therefore, discharge from Grays Bay outlet was subtracted from the total discharge measured at the USGS gage prior to running these analyses. Groundwater recharge and discharge as estimated from Minnehaha Creek's flow record are summarized in Table 1.

The recharge estimate produced through RORA (2.7 in yr^{-1}) represents effective recharge over the watershed under the assumption that the only loss from the surficial aquifer system is stream discharge. However, given the predominance of coarse-textured surficial sediments in the lower watershed, it is likely that the Quaternary aquifer supplies deeper bedrock aquifers as well. The differences between available recharge and that which is translated to stream baseflow is of interest given our objective of supplying baseflow through infiltrated runoff. For this reason, we compared RORA recharge estimates with those produced through two methods of watershed-wide recharge previously applied to the region. Recharge, as estimated by Lorenz and Delin

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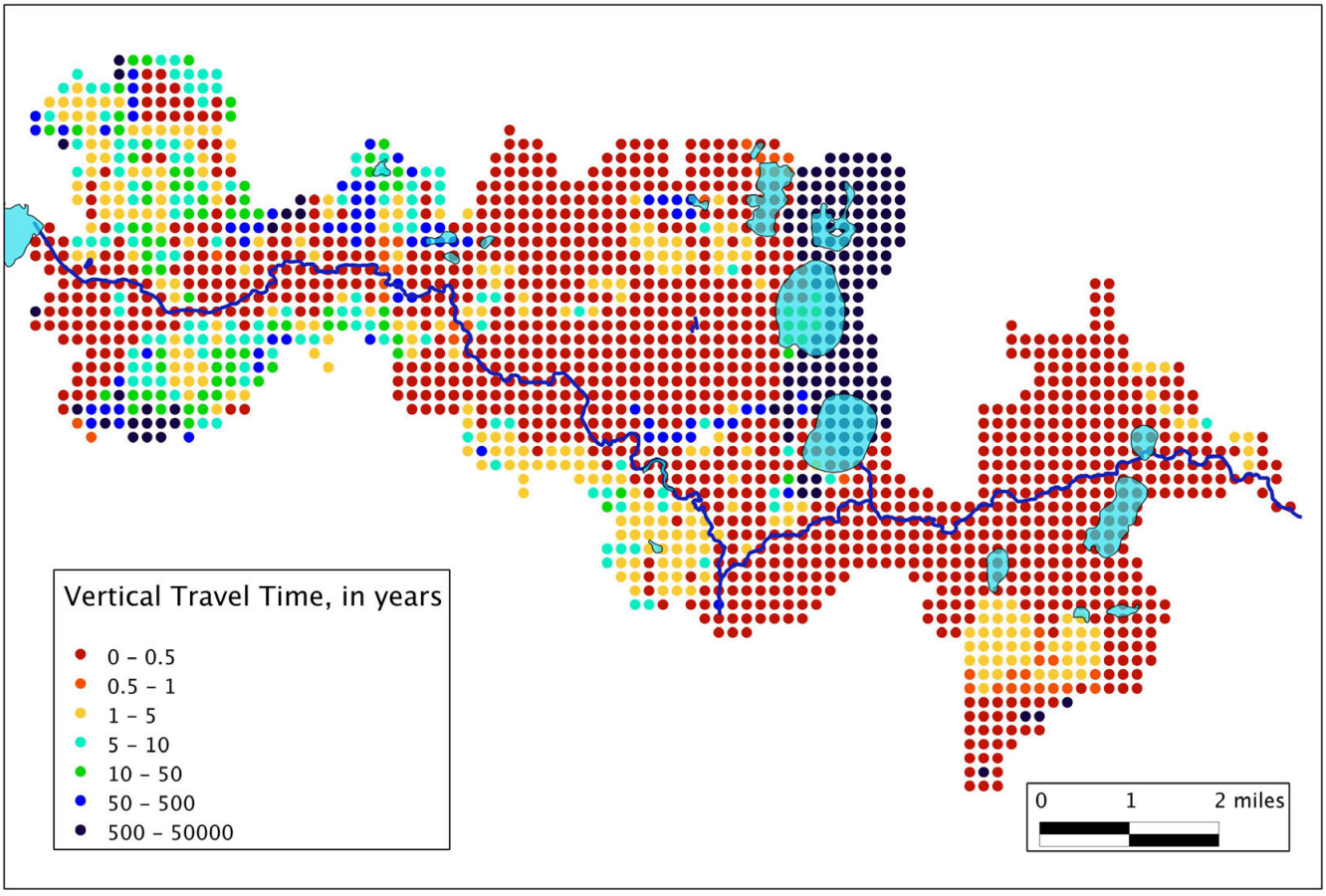

Figure 2. Vertical travel time, land surface to the surface of the uppermost bedrock unit, as calculated by Tipping (2011). Groundwater discharge to Minnehaha Creek may be limited in part by rapid vertical transit through quaternary sediments, the median travel time of which was 0.5 years.

Table 1. *Summary results of streamflow-based groundwater recharge (RORA) and discharge (PART and baseflow filter) estimates. Watershed-wide recharge as estimated through the Soil Water Balance (SWB) and Regional Regression Recharge (RRR) models for the study area are also presented for comparison with RORA.*

Estimated groundwater recharge (in yr^{-1})		
RORA recession index model (USGS)	2.7	(streamflow record: 2006 – 2011)
SWB model (Metropolitan Council, 2009)	7.9	(available recharge, 1977 – 2011)
RRR model (Delin et al., 2007)	6.5-8.5	(available recharge, 1971 – 2000)
Estimated groundwater discharge (in yr^{-1})		
PART baseflow separation model (USGS)	1.35	(streamflow record: 2006 – 2011)
Baseflow filter (Nathan and Mahon, 1990)	1.5	(streamflow record: 2006 – 2011)

(2007) using the Regional Regression Recharge (RRR) model ranged from 6.5-8.5 inches across the lower Minnehaha Creek watershed. Their model incorporates soil and climate variables in a linear regression model to produce regionalized recharge estimates. Similar recharge estimates were produced with the SWB model (Westenbroek et al., 2010), a spatial model applied to the Twin Cities area by the Metropolitan Council (2009) using watershed elevation, soil, land cover, and climatic data sets. The Metropolitan Council's original SWB model included climate data from 1977 to 2003; we conducted additional model runs to extend recharge predictions to 2011. RRR and SWB recharge estimates are also presented in Table 1.

The discrepancy between streamflow-based RORA recharge and watershed-wide RRR and SWB methods suggests that the surficial aquifer system underlying the Minnehaha Creek watershed is indeed leaky. Further investigation of the properties of the shallow aquifer system indicated that this is likely the case. We applied the method of Brutsaert and Nieber (1977) to low flow periods in Minnehaha Creek to infer physical properties of the shallow aquifer system (hydraulic conductivity, porosity, and the fraction of the watershed underlain by stream-feeding aquifers). This method is derived from the nonlinear solution of the *Boussinesq* equation, and is executed by plotting the change in discharge against discharge (Figure 3). A regression model of the power function describing storage in a non-linear aquifer is then fit to the lower envelope of flow data, which is taken to

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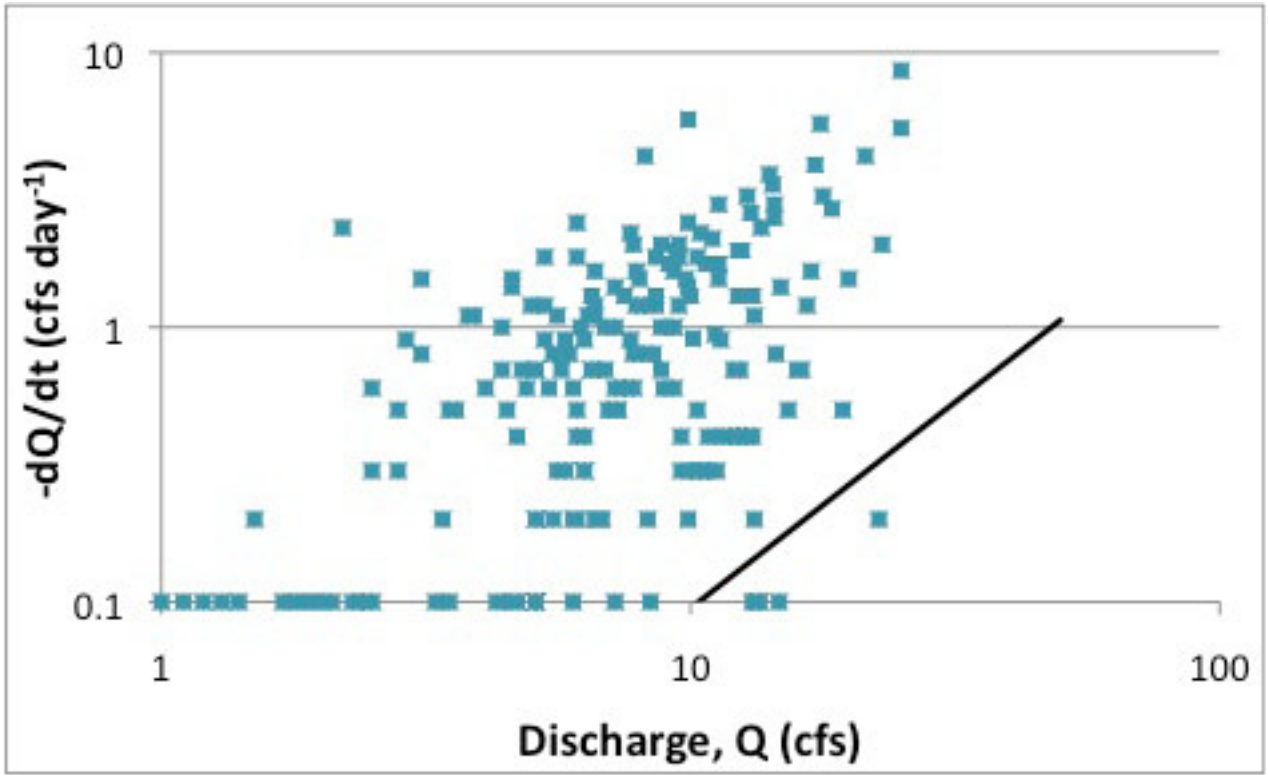

Figure 3. Application of approach outlined by Brutsaert and Nieber (1977) to relate streamflow to physical aquifer characteristics. Values of coefficients a (0.002) and b (1.5) were obtained from the regression line fitted to the lower envelope of flow data. Following substitution into Boussinesq's nonlinear solution for groundwater flow, one can obtain estimates for hydraulic conductivity k, porosity f, and fraction of the aquifer feeding the stream α based on the value of regression coefficient a, watershed area A, and total stream system length L.

Minnehaha Creek, cont.

be representative of groundwater-fed baseflow. Based on the expected range of values of hydraulic conductivity and porosity from existing surficial mappings, the contributing aquifer must represent a small fraction of the total watershed area (< 0.1%) to satisfy resulting regression coefficients. For perspective, this area amounts to an approximately 15-ft wide buffer on either side of the creek. That the contributing aquifer system is likely small is in accordance with the rapid vertical travel through the Quaternary aquifer system calculated by Tipping (2011).

Field Studies

In combination with existing geologic datasets, our analysis of streamflow data to infer aquifer properties and potential groundwater recharge and discharge indicate that sustained baseflow during drought periods in Minnehaha Creek is likely limited by rapid vertical transit of groundwater through the shallow aquifer system. We are currently employing a variety of field approaches to expand what we've learned from streamflow analysis and to provide the underpinnings for subsequent modeling efforts. Field methods include the use of stable isotopes, temperature, seepage measurements, and shallow well installation and monitoring, each of which is summarized in the following.

Streamflow source-tracking with isotopes

Stable isotopes, such as those of oxygen (^{16}O and ^{18}O) and hydrogen (^{1}H and ^{2}H) can be useful tracers in hydrologic studies such as this. By measuring the relative abundance of ^{18}O and ^{2}H isotopes in Minnehaha Creek and its flow sources (precipitation, stormwater runoff, lakes, and groundwater), we aim to characterize the isotopic signature of these sources and, through the application of mixing models, develop estimates of the relative contribution of each during high and low flow periods in the creek. Differences in the isotopic composition of the creek and its various flow sources arise due to a combination of physical, chemical, and biological processes through which fractionation, or change in the ratio of heavy to light isotopes, occur. Evaporation is one such fractionation process, and is a likely cause for enrichment of heavier isotopes in contributing Lakes Minnetonka and Harriet (as indicated by the larger ^{2}H and/or ^{18}O delta values in Figure 4) observed in preliminary isotope data. The isotopic composition of Minnehaha Creek represents a mixture of meteoric water and, particularly during the receding limb of the storm hydrograph, of Lakes Harriet and Minnetonka. The influence of Lake Minnetonka is strongest at the Jidana wetland site, located only two miles downstream of Minnetonka's outlet. However, the isotopic signature of Minnetonka waters is obscured in samples taken further downstream in the creek. Although groundwater isotope data from the study sites is not yet available, its isotopic composition is expected to align more closely with that of the mean isotopic composition of precipitation in the region. Given this expectation, preliminary isotope data from Minnehaha Creek does not suggest substantial groundwater contributions. However, isotope data from groundwater monitoring wells and the creek during low-flow conditions is needed to properly interpret the preliminary data.

Temperature as a groundwater tracer

Just as ground and surface water sources may be distinguished on the basis of their isotopic composition, they often also differ

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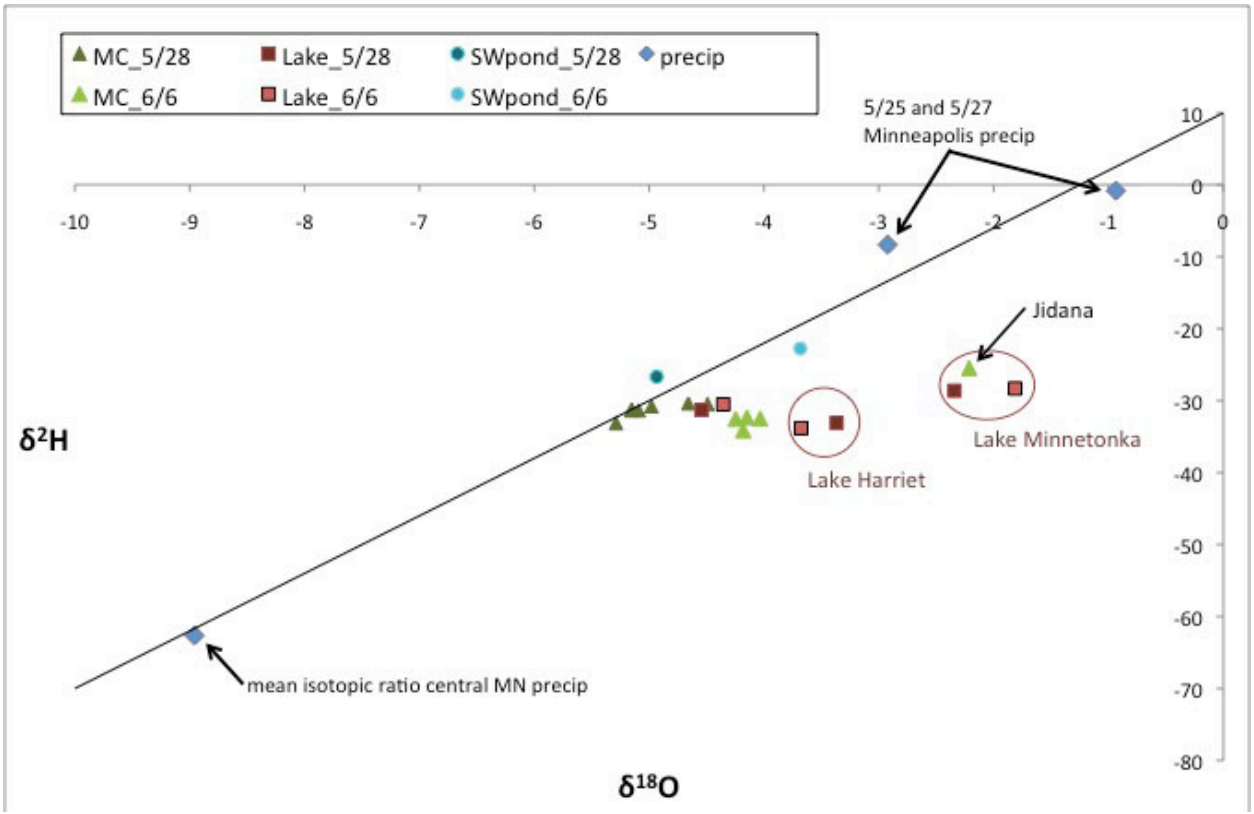

Figure 4. Preliminary isotope data from Minnehaha Creek, calculated as the abundance of 2H and 18O isotopes relative to the international standard (mean of ocean water). The relative abundance of heavy isotopes increases with δ values. Isotope data were collected near the peak (May 28) and during the recession limb (June 6) of the hydrograph following a series of storms that produced over 4 inches of rainfall.

Minnehaha Creek, cont.

in their temperature. The horizontal and vertical temperature distribution in streambed sediments is a result of both convective transport by water flowing in the creek and conduction through the streambed matrix. Temperature gradients between the stream surface and the underlying streambed can easily be measured and used to estimate groundwater flux rates in computational models.

We have taken preliminary temperature measurements in the stream and underlying bed sediments using a temperature probe (Hannah Instruments) along the length of Minnehaha Creek and are using these data to identify sites at which thermistors installed at 0.5-ft intervals in the streambed will be placed to monitor changes in temperature gradients between the surface and bed sediments over time. Temperature probe data are also being analyzed using a simple, one-dimensional heat transfer model to produce a first-order approximation of groundwater fluxes at probed locations.

Establishing hydraulic gradients of shallow groundwater

We have installed a series of shallow wells perpendicular to the channel within the creek's riparian area at two locations along the creek. Additional sites will be instrumented in the near future. Simultaneous measurements of stream stage and groundwater elevation at these locations will provide a view of the dynamics of stream-aquifer interactions (Figure 5a) and give additional insight to the potential to convert runoff infiltrated in the near-stream aquifer to base flow.

Seepage Measurements

Finally, we are also using seepage meters to directly measure groundwater discharge within the creek (Figure 5b). Previous seepage measurements were made in 2003 by Lundy and Ferrey (2004) at one location of the creek in association with the monitoring of a contaminated groundwater plume. At this location, measured seepage rates ranged from 0.3 to 19 in/day, a range which gives some indication of the heterogeneity of streambed materials and associated groundwater discharge. We will be repeating seepage measurements at this site and others where groundwater elevation, isotope, and temperature data have also been collected. Though simple in theory and construction, obtaining reliable field data from seepage meters is complicated by a myriad of factors and will be best interpreted in light of supporting temperature and isotope analyses from these sites.

Summary and Conclusions

By applying the suite of complimentary field approaches outlined above, we hope to gain a more detailed understanding of the groundwater interactions with Minnehaha Creek. Such an understanding is needed as we prepare to move into the modeling phase of this project to develop more specific guidance related to optimal placement of stormwater infiltration practices within the watershed.

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Figure 5. (a) Measuring temperature, level, and conductivity in a shallow well near Minnehaha Creek. (b) Preparing to install seepage meters in Minnehaha Creek.

MATRIX ENVIRONMENTAL LLC

Environmental Technician (Geoprobe Operator)

Matrix Environmental, LLC has an opening for a responsible person to work with our Geoprobe® and drilling operations. Fieldwork includes direct push soil coring, soil gas, and groundwater sample collection; monitoring well installation; and direct sensing activities. Individual needs to work well in a team.

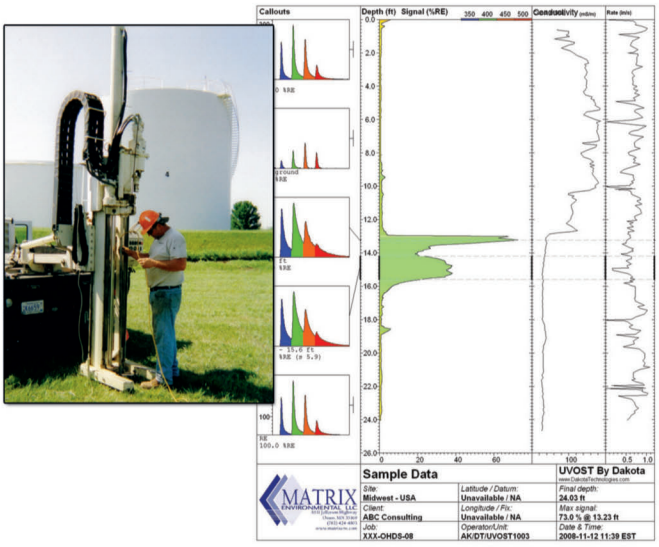
- **Ability to operate mechanical equipment and vehicles is required. Work will be outdoors in all weather conditions. Heavy lifting is to be expected.**
- **Must have a valid driver's license and clean driving record. Out of town travel required.**
- **40-hour OSHA Hazmat training and field experience is a plus.**
- **Full benefits including medical, dental, 401K and paid vacation.**
- **Employer paid pre-employment physical and drug screening required.**

Office in northwest Metro of Twin Cities. Send resume to: jdzubay@matrixenv.com

MATRIX ENVIRONMENTAL LLC

Site Characterization Professionals

- **Geoprobe®**
  4x4 Trucks, All-Terrain Vehicles & Portable Units
- **Direct Sensing**
  UVOST - Laser Induced Fluorescence, Membrane Interface Probe (MIP), Electrical Conductivity Logging Hydraulic Profiling Tool (HPT), Soil Color Optical Screening Tool (SCOST)
- **Mobile Lab**
  VOCs, Hydrocarbons, PCBs, PCP, PAHs & Metals



Our ultra-violet optical screening tool (UVOST) is specifically designed for delineating the NAPL found at Petroleum, Oil, Lubricant (POL) sites. UVOST can be deployed by all forms of direct push across a wide range of site conditions.

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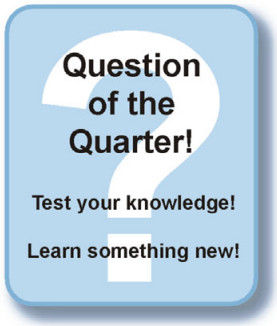


Question of the Quarter

The Question of the Quarter is an occasional feature of your newsletter in which a question is posed and all members are invited to respond.

The Question of the Quarter in the June issue was:

What is new name for the formation that MGS has adopted for the Ironton-Galesville and in what county can you find the type section?

Scot Johnson of Red Wing got it right. It is the Wonewoc Formation with its type section found in Juneau County, Wisconsin.

Now for more historical geology, our new Question of the Quarter for September is:

What formation found in Minnesota was subdivided by MGS into two groups in 1995? What are the two groups now called?

Send your answer to editor@mgwa.org

Minnesota Ground Water Association Board Meeting Minutes

Meeting Date: June 4, 2012

Location: Fresh Grounds Café 1362 West 7th Street, St. Paul, MN

Attendance: Kelton Barr, President; Mindy Erickson, Past President; Audrey Van Cleve, Treasurer; Julie Ekman, Secretary; Sean Hunt, WRI; Jeanette Leete, WRI; Bob Tipping, President-Elect.

Past Minutes: May minutes approved as amended.

Treasury: Copies of the report were provided. Income to date is $55,970.88; expenses to date: $37,215.57; leaving a net income of $18,755.31 ($13,693 of this was from the Spring Conference fees). Total Current Assets: $51,061.61.

Newsletter: Barr provided the report on behalf of Ronning. The June issue has been handed off to WRI and will be published mid-month. Ronning has emailed the Spring Conference poster presenters encouraging them to provide abridged versions of their work for the fall newsletter as well as full poster information for the MGWA website.

Web Page: Hunt reported that the public web pages will include conference agendas, abstracts, and full poster information (providing the complete poster work on the public site allows the presenters to fully cite their work in other publications). Audios of the presentations will be reserved for the members-only web pages for two years before they will be offered on the public web pages.
Midwest Ground Water Conference website is linked from the MGWA site and includes information on accommodations. Barr has been receiving the list of invited speakers and their talk titles; these can now be included under the session topics. It's time to send out a call for papers. Also, Barr noted that there will be a Super Shuttle available from the airport as an option for those who don't want to rent a car.
Tipping suggested that the website should include "as of" dates so that it's clear the agenda is a work in progress. Barr suggested that a "save the date" email be sent – he has contacted the previous MW GW Conference sponsors in Kentucky to request the email list for attendees.

WRI Report: Leete is working on taxes. Hunt is working on email cleanup and will send a list of 'bad' addresses to Board members to provide any updated information they are aware of.

Foundation: Erickson reported that the Foundation met on May 22nd and approved funding of the Washington County educational ground water model. They discussed revisions to the process for awarding student scholarships. Leete has checked laws pertaining to scholarship award processes: the MN IRS must be informed of the process that will be followed; however the Foundation is not required to receive approval for that process. The scholarship must be made broadly available and, as an indicator of this, there should be at least 10 applicants. The Foundation continues discussion on whether the scholarship will be available to under-graduates or graduate students. By the end of this year, approximately $2,000 of interest money will be available.

Old Business: Midwest Ground Water Conference — Barr reported that he is looking into revenue sources to provide money for invited MW GW Conference speakers to offset their expenses. Businesses have begun offering sponsorship money and services for the conference. Braun Intertec will sponsor the bartender and drink tickets; HDR will help design a layout plan for vendor booths and design reservation forms (Leete will review other conference booth reservation forms). Other ideas for sponsorship were discussed along with estimated values; businesses could sponsor the field trip ($1,000), the bags that will be handed out to attendees ($2,000), lanyards for name tags ($1,000), ads in the abstracts book ($500), a speaker session ($500), the banquet ($TBD), or refreshments during breaks ($TBD).
Six people have volunteered to help with underwriting the conference. They will meet in mid-June.
2013 Spring Conference will be April 24, 2013.

Meeting Date: July 3, 2012

Location: Fresh Grounds Café, 1362 West 7th Street, St. Paul, MN

Attendance: Kelton Barr, President; Mindy Erickson, Past President; Bob Tipping, President-Elect; Julie Ekman, Secretary; Audrey Van Cleve, Treasurer; Sean Hunt, WRI; Jeanette Leete, WRI

Past Minutes: June minutes approved as amended.

Treasury: Copies of the report were provided. Income to date is $57,657.16; expenses to date: $41,153.68; leaving a net income of $16,503.48. Total Current Assets: $52,524.92.

Newsletter: Deadline is August 3rd.

Web Page: Hunt reported that the June newsletter has been published. Announcements and call for abstracts have been sent for the Midwest Ground Water Conference. Conference attendees' email list has been obtained from the previous host state (Kentucky) and the list has been updated.

WRI Report: Leete provided a written report. The MGWA member listing on the web page is being updated every other week when there is significant membership activity.

The MGWA Board of Directors meets once a month.

All members are welcome to attend and observe.

MGWA 2012 Membership Dues

Professional Rate:	$35
Full-time Student Rate:	$15
Newsletter (printed and mailed)	$20
Directory	$7

Membership dues rates were revised at the October 1, 2010 meeting of the MGWA Board. The Board intends to balance the membership services budget.

MGWA BOARD MINUTES

MGWA Minutes, cont.

Foundation: Erickson reported that the Foundation approved a grant to the Metro Childrens Water Festival.

Old Business: Midwest Ground Water Conference — The dates of the Midwest Ground Water Conference are October 1-3. Barr reported that Jim Aiken is heading up a group of 7 people that are raising funds for the conference. They are making progress on raising funds for sponsorships of various aspects of the conference including food, breaks, sessions, portfolios, booths, tables. A volunteer is coordinating the booth and table registrations. The session topics can be posted on the website; Hunt can send the email notice that registration is now open.
Potential speakers need to indicate a session topic for their abstracts.
The Frack sand conference website is not yet established. Barr will contact them about this; their website will be linked from the MWGC website.
Tipping will seek bids from bus services for the field trip.
Health Department's upgrade of the County Well Index — Barr is soliciting MGWA Board and member ideas/input for the Health Department's upgrade of the County Well Index

New Business: Erickson will get a cost estimate from GTS Educational for printing conference brochures and also for approximately 300 field trip brochures.

Earth Science Week 2012 "Discovering Careers in the Earth Sciences"

The theme of Earth Science Week 2012 is "Discovering Careers in the Earth Sciences." This year's event will boost awareness about the geosciences and the many exciting career and job opportunities in the field. The American Geological Institute (AGI) leads Earth Science Week annually in cooperation with its sponsors and the geoscience community as a service to the public. Each year, community groups, educators, and interested citizens organize celebratory events. Earth Science Week offers the public opportunities to discover the Earth sciences and engage in responsible stewardship of the Earth. Earth Science Week is supported by the U.S. Geological Survey, the American Association of Petroleum Geologists Foundation, NASA, the National Park Service, ExxonMobil, and Esri.

Earth Science Week 2012 materials and activities will engage young people and others in learning how geoscientists gather and interpret data about the Earth and other planets. Through careers in geology, geophysics, oceanography, hydrology, paleontology, Earth science education, and many other fields, they enhance our understanding of Earth processes and improve the quality of human life.

"With this year's focus on jobs, Earth Science Week provides a great chance for teachers and guidance counselors to spread the word to students and parents about geoscience careers," says Ann Benbow, AGI's Director of Education and Outreach. "With over 150,000 positions expected to open in the next decade, opportunities for building an exciting and meaningful career in the geosciences have never been better, even in this tough economy," says Christopher M. Keane, head of AGI's Geoscience Workforce Program.

Earth Science Week 2012 will be celebrated October 14-20. For more about this week and ways to get involved -- including newsletters, local events, and classroom activities -- please see the Earth Science Week web site www.earthsciweek.org

FOUNDATION UPDATE

The Minnesota Ground Water Association Foundation is Proud to Announce a Scholarship Opportunity

The Minnesota Ground Water Association Foundation is pleased to announce that they will soon be offering a $1,000 scholarship for students interested in hydrogeology, groundwater geology and related professions. Any student enrolled as an undergraduate or graduate student in hydro-geology, groundwater hydrology or a similar program at an accredited college or university in Minnesota or adjoining state or province is eligible to apply.

To find the application and additional information about the scholarship, go to: www.mgwa.org/foundation

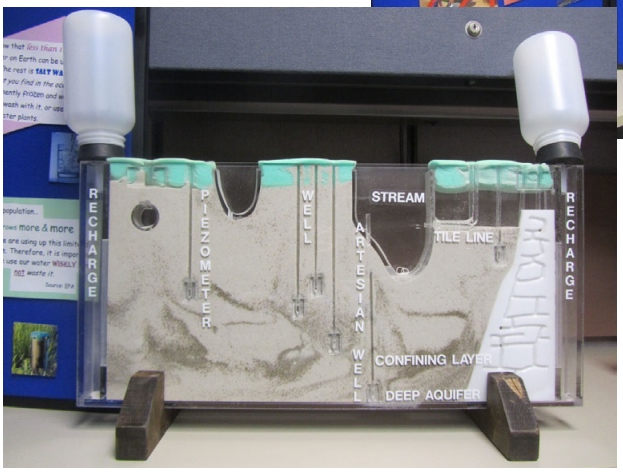
MGWA Newsletter Staff

Washington County Youth Education

Washington County recently acquired a groundwater flow model with funds from the **Minnesota Groundwater Association Foundation** and created a groundwater display which will be used as an educational exhibit within the community and at water festivals around the region.

The groundwater flow model provides an interactive way to emphasize how water and other contaminants move underground. The display provides information on the water cycle, the nature of groundwater and the importance of keeping groundwater clean.

Groundwater provides 100% of the drinking water in the county!



Washington County

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The MGWA Foundation is a 501(c)3 charitable organization. Donations to the Foundation are deductible on your state and federal income tax returns.